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# NOTICE OF ALLOWANCE AND FEE(S) DUE

7590 03/09/2004

Morris Liss
Connolly Bove Lodge & Hutz
PO Box 19088
Washington, DC 20036-3425

| EXAMINER |
|---|
| TO, BAOQUOC N |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2172 | 3 |

DATE MAILED: 03/09/2004

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 09/913,960 | 08/21/2001 | Yuji Kanno | 21900/0035 | 8017 |

TITLE OF INVENTION: VECTOR INDEX PREPARING METHOD, SIMILAR VECTOR SEARCHING METHOD, AND APPARATUSES FOR THE METHODS

| APPLN. TYPE | SMALL ENTITY | ISSUE FEE | PUBLICATION FEE | TOTAL FEE(S) DUE | DATE DUE |
|---|---|---|---|---|---|
| nonprovisional | NO | $1330 | $300 | $1630 | 06/09/2004 |

**THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.**

**THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE REFLECTS A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE APPLIED IN THIS APPLICATION. THE PTOL-85B (OR AN EQUIVALENT) MUST BE RETURNED WITHIN THIS PERIOD EVEN IF NO FEE IS DUE OR THE APPLICATION WILL BE REGARDED AS ABANDONED.**

**HOW TO REPLY TO THIS NOTICE:**

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:
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B. If the status is changed, pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above and notify the United States Patent and Trademark Office of the change in status, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check the box below and enclose the PUBLICATION FEE and 1/2 the ISSUE FEE shown above.

☐ Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

II. PART B - FEE(S) TRANSMITTAL should be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). Even if the fee(s) have already been paid, Part B - Fee(s) Transmittal should be completed and returned. If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

**IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.**



PTOL-85 (Rev. 11/03) Approved for use through 04/30/2004.

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**Complete and send this form, together with applicable fee(s), to: Mail** **Mail Stop ISSUE FEE**
**Commissioner for Patents**
**P.O. Box 1450**
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**or Fax** **(703) 746-4000**

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CURRENT CORRESPONDENCE ADDRESS (Note: Legibly mark-up with any corrections or use Block 1)

7590 03/09/2004

Morris Liss
Connolly Bove Lodge & Hutz
PO Box 19088
Washington, DC 20036-3425

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**Certificate of Mailing or Transmission**

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO, on the date indicated below.

| |
|---|
| (Depositor's name) |
| (Signature) |
| (Date) |

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 09/913,960 | 08/21/2001 | Yuji Kanno | 21900/0035 | 8017 |

TITLE OF INVENTION: VECTOR INDEX PREPARING METHOD, SIMILAR VECTOR SEARCHING METHOD, AND APPARATUSES FOR THE METHODS

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|---|---|---|---|---|---|
| nonprovisional | NO | $1330 | $300 | $1630 | 06/09/2004 |

| EXAMINER | ART UNIT | CLASS-SUBCLASS |
|---|---|---|
| TO, BAOQUOC N | 2172 | 707-005000 |

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. Inclusion of assignee data is only appropriate when an assignment has been previously submitted to the USPTO or is being submitted under separate cover. Completion of this form is NOT a substitute for filing an assignment.

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❑ Publication Fee

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(Authorized Signature) (Date)

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This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, Alexandria, Virginia 22313-1450.

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| EXAMINER | |
|---|---|
| TO, BAOQUOC N | |
| **ART UNIT** | **PAPER NUMBER** |
| 2172 | |

DATE MAILED: 03/09/2004

**Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)**
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 371 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 371 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) system (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (703) 305-1383. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at (703) 305-8283.



PTOL-85 (Rev. 11/03) Approved for use through 04/30/2004.

| Notice of Allowability | Application No. | Applicant(s) |
|---|---|---|
| | 09/913,960 | KANNO, YUJI |
| | Examiner | Art Unit |
| | Baoquoc N To | 2172 |

5/8

***-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--***

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *01/17/04*.

2. ☒ The allowed claim(s) is/are *1-29*.

3. ☒ The drawings filed on *21 August 2001* are accepted by the Examiner.

4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☒ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

6. ☐ CORRECTED DRAWINGS ( as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review ( PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

**Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**

7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

## DETAILED ACTION

1. Claims 1-29 are pending in this application. Claims 1-2, 10-11, 15-16 and 23-24 are amended in the amendment filed on 02/17/04.

## EXAMINER'S AMENDMENT

2. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Mr. Morris Liss on 03/04/05.

In claim 10, please replace in line 1, [similar] with "similarity"

In claim 11, please replace in line 1 [similar] with "similarity"

In claim 23, please replace in line 1 [similar] with "similarity"

In claim 24, please replace in line 1 [similar] with "similarity"

### *Allowable Subject Matter*

3. Claims 1-29 are allowed over the cited references made of records.

The following is an examiner's statement of reasons for allowance: None of the known prior art alone or incombination neither teaches nor suggest:

For claims 1 and 15, "a first step of vector index preparation of dividing N components into m ordered lists in a predetermined method with respect to the N-dimensional real vector V of each vector data in said vector database, preparing m. partial vectors v1 to vm, subsequently tabulating a distribution of a norm of the partial

vector vk (k = I to m), preparing a norm partition table which contains a predetermined number of norm ranges, calculating a region number d to which said partial vector vk belongs in. accordance with predetermined D region center vectors p1 to pd, tabulating a distribution of a cosine (Vk*Pd)/(IVkI *IPdI) of an angle formed by said partial Vector Vk and the region center vector pd as a declination distribution, and preparing a declination partition table which contains a predetermined number of declination ranges; a second step of the vector index preparation of dividing N components into m ordered lists in the same method as said first step with respect to the N-dimensional real vector V of each vector data in said vector database, preparing m partial vectors v1 to Vm referring to said norm partition table, to calculate a number r of the norm partition to which the norm of said partial vector Vb belongs with respect to the partial vector vb (b = I to m) for the partial space number b, calculating the region number d to which said partial vector vb, belongs in accordance with the predetermined D region center vectors p1 to pd in the same method as said first step, calculating a declination (Vb*Pd)/(IVbI*IPdI) as a cosine of an angle formed by said partial vector vb and the region center vector Pd indicating a center direction of the region of said region number d, referring to said declination partition table, calculating a number c of the belonging declination partition, and calculating index registration data to be registered. in a vector index from said partial space number b, said region number d, said declination partition number c, said norm partition number r, the component of said partial vector vb, and the identification number i; and a third step of the. vector index preparation of constituting the vector index such that the identification number and the component of each partial

vector can be searched using a ordered list of the partial space number b, the region number d, the declination partition number c and a norm partition number range (r1-r2) as a key from said -norm partition table, said declination partition table, and said index registration data, and such that the vector component of each vector data cart be searched with the identification number of the vector component."

For claims 2-9 and 16-22, "a first step of vector index preparation of dividing N components into m ordered lists in a predetermined method with respect to the N-dimensional real vector V of each vector data in said vector database, preparing in partial vectors v1 to vm, Subsequently tabulating a distribution of a norm of the partial vector vb (b = 1 to m) for each partial space number b, preparing a norm partition table which contains a predetermined number of norm ranges, calculating a region number d to which said partial vector vb, belongs in accordance with predetermined D region center vectors p1 to pd, tabulating a distribution of a cosine (Vb*Pd)/(IVbI*IPdI) of an angle formed by said partial vector vb and the region center vector pd as a declination distribution, and preparing a declination partition table which contains a predetermined number of norm ranges; a second step of the vector index preparation of dividing N components into m ordered lists in the same method as said first step with respect to the N-dimensional real vector V of each vector data in said vector database, preparing rn partial vectors v, to v, referring to said norm partition table to calculate a number r of the norm partition to which the norm of said partial vector vb belongs with respect to the partial vector vb (b = 1 to m) for said partial space b, calculating the region number d to which said partial vector vb belongs in accordance with the predetermined D region

center vectors p, to PD in the same method as said first stop, calculating a declination (Vb,*Pd)/(IVbl*lPd]) as a cosine of an angle formed by said partial vector vb, and the region center vector Pd indicating a center direction of the region of said region number d, referring to said declination partition table, calculating a number c of the belonging declination partition, calculating a component partition number wj of a predetermined range to which vbj belongs from a maximum value Of the norm of the norm partition corresponding to said calculated norm partition number r with respect to each component vbj of said calculated partial vector Vb, and calculating index registration data to be registered in a vector index from said partial space number b, said region number d, said declination partition number c, said norm partition number r, a string of said component partition numbers wj and the identification number i; and a third step of the vector index preparation of constituting the vector index such that the identification number and the component of each partial vector can be searched using a ordered list of the partial space number b, the region number d, the declination partition number c and a norm partition number range (r1-r2) as a key from said norm partition table, said declination partition table, and said index registration data, and such that the vector component of each vector data can be searched with the identification number of the vector component."

For claims 10 and 23, "a first step of similar vector search of dividing N components of Q into m ordered lists in the same predetermined method as a method used in preparing said vector index with respect to said query vector Q preparing m partial query vectors q1 to qm calculating a partial inner product lower limit value fb as a

lower limit value of an a partial inner product of each partial query vector qb and the corresponding partial vector from a designated inner product lower limit value a, calculating a partial space number b, and an ordered list (c,r1, r2)) of a declination partition number c to be searched in a region number d and a norm partition range (r1-r2) from a value of an inner product pd*qb of the region center vector pd and said partial query vector (1b, said partial inner product lower limit value fb, and a norm partition table and a declination partition table in said vector index with respect to each partial query vector qb (b = I to m) and each region b, searching a range of said vector index using (r1-r2) as a search condition based on said calculated (c, r1-r2), obtaining the identification number i and the component of the partial Vector Vb satisfying the condition as an index search result, calculating a partial inner product difference (Vb*qb)-fb as a difference between a partial inner product Vb*qb of said vb and qb and said partial inner product lower limit value fb, and accumulating (adding) the difference as an inner product difference upper limit value S(i) of the identification number i of an inner product difference table; and a second step of the similar vector search of searching said vector index with the identification number i in order from a largest value in said inner product difference table S(i) to obtain a vector data component V, calculating an inner product difference value t = V*Q-$\alpha$ by subtracting a- from the inner product V*Q of V and said query vector Q, and outputting an ordered list of at least the identification -number i and all inner product t+$\alpha$ as a search result with respect to L pieces, at maximum of vector data with a large inner product difference value when L or more pieces of vector data having the inner product difference value larger than a

maximum value of an element having a non-calculated inner product difference value are collected, or when the inner products of all the vector data having a positive inner product difference upper limit value are calculated in said inner product difference table."

For claims 11-14 and 24-29, "a first step of similar vector search of dividing N components of Q into m ordered lists in the same predetermined method as a method used in preparing said vector index with -respect to said query vector Q, preparing m partial query vectors q1 to qm, calculating a partial square distance upper limit value fb as an upper limit value of a partial square distance lVb-qbl2 (i.e.,) corresponding to square of Euclidean distance, of each partial query vector qb and the corresponding partial vector vb, from a designated distance upper limit value $\alpha$ , systematically generating an ordered list (b, d, c (r1-r2)) of a partial space number b to be searched, a region number d, a declination partition number c and a norm partition range (r1-r2) from said partial query vector qb, said partial square distance upper limit value fb, and a norm partition table and a declination partition table in said vector index with respect to each partial query vector qb (b = 1 to m), searching a range of said vector index using said generated (b, d, c, (r1-r2)) as a search condition, obtaining the identification number i and the component of the partial Vector Vb Satisfying the condition as an index search result, calculating a partial square distance difference fb-lvb-qb| as a difference between said partial square distance upper limit value fb and a partial square distance |vb-qb|2 of vb and qb, and accumulating (adding) the difference as a square distance difference upper limit value S(i) of the identification number i of a square

distance difference table; and a second step of the similar vector search of searching said vector index with the identification number i in order from a largest value in said square distance difference table S(i) to obtain a vector data component V, calculating a square distance difference value a2-IV-QI2 by subtracting a square distance IV-QI2 of V and said query vector Q from a squared distance upper limit value $\alpha$ and outputting an ordered list of at least the identification number i and a distance ($\alpha$ 2t)1/2 as a search result with respect to L pieces at maximum of vector data with a large square distance difference value t when L or more pieces of vector data having the square distance difference value larger than a maximum value of an element having a non-calculated square distance difference value are collected, or when the square distance difference values of all the vector data having a positive square distance difference upper limit value are calculated in said square distance difference table."

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

***Conclusion***

4. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

| | |
|---|---|
| Corey et al. (US. Patent No. 5,987,446) | Patent date: 11/16/1999 |
| Agrawal et al. (US. Patent No. 5,647,058) | Patent date: 07/08/1997 |
| De Bonet (US. Patent No. 5,819,288) | Patent date: 10/06/1998 |

(Indexing large metric spaces for similarity search queries)

Keogh et a. (page 56-67) Publication date : 07/28/1999

(An indexing scheme for fast similarity each in large series database)

***Contact information***

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Baoquoc N. To whose telephone number is (703) 305-1949 or via e-mail BaoquocN.To@uspto.gov. The examiner can normally be reached on Monday-Friday: 8:00 AM – 4:30 PM, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Breene can be reached at (703) 305-9790.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-3900.

Any response to this action should be mailed to:

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Washington, D.C. 20231.

The fax numbers for the organization where this application or proceeding is assigned are as follow:

(703) 872-9306 [Official Communication]

Hand-delivered responses should be brought to:

Crystal Park II
2121 Crystal Drive
Arlington, VA 22202
Fourth Floor (Receptionist).

Baoquoc N. To
Feb 17, 2004

ALFORD KINDRED
PRIMARY EXAMINER